## REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended claim 3 to recite the "water-retaining layer", rather than porous member; and have amended each of claims 5-7 to recite the water permeable "layer", rather than membrane.

Applicants have amended claim 33 to recite a holder for the water-retaining layer, wherein a surface of the holder for the water-retaining layer and an adjacent surface of the water-retaining layer are in contact over entire surfaces thereof. In connection with recitation of contact over entire adjacent surfaces, note, for example, Figs. 2 and 5 of Applicants' original disclosure, with contact over entire adjacent surfaces between the holder 206 and water-retaining layer 203, and with contact over entire adjacent surfaces of the water-retaining layer 203 and the water permeable layer 201.

Applicants have further amended claim 33 to recite that the porous water-retaining layer is in communication with a channel containing water by way of a filter between the channel and the water-retaining layer for passing water, but not gas, from the channel to the water-retaining layer, as seen in, e.g., Fig. 5. In addition, Applicants have amended each of claims 47 and 48 to recite a unit fuel cell comprising "a membrane electrode assembly", to recite a humidifier holding member instead of a holder, and to delete recitation that the humidifier holding member is for holding peripheries of the separator; and Applicants have further amended claim 48 to recite that the separator has a gas channel facing the water-retaining layer on one

face, and to delete recitation of a humidifier holding member for holding peripheries of, inter alia, the water permeable layer.

In addition, Applicants are adding new claims 49-54 to the application. Claim 49, dependent on claim 33, recites that the water-retaining layer is positioned and has structure such that water osmoses into and through the water-retaining layer by capillary action so as to be supplied from said channel to the flow channels thereby to transfer water introduced into the water-retaining layer to the fuel gas and/or oxidizing gas flowing in the flow channels. Note, for example, the last full paragraph on page 11 of Applicants' specification. Claims 50 and 51, dependent respectively on claims 47 and 48, recite surfaces of the humidifier holding member, water-retaining layer and water permeable layer, as appropriate, in contact over entire adjacent surfaces thereof.

New independent claim 52 defines a fuel cell assembly including a humidifier and a plurality of fuel cell units, such fuel cell units being defined consistently with that set forth in claim 33, with claim 52 reciting that the humidifier comprises a water permeable layer, a porous water-retaining layer for retaining water supplied thereinto and a holder for the water-retaining layer, wherein a surface of the holder for the water-retaining layer and an adjacent surface of the water-retaining layer are in contact over entire adjacent surfaces thereof, and a surface of the water-retaining layer and an adjacent surface of the water-permeable layer are in contact over entire adjacent surfaces thereof, claim 52 further reciting that the porous water-retaining layer is in communication with a channel containing water by way of an edge of the water-retaining layer in contact with the channel, for passing water, but not gas, the channel containing water exclusively supplying water to the water-retaining layer

supplying water thereto via the edge of the water-retaining layer, with the water-retaining layer communicating with the channel containing water only by way of the edge of the water-retaining layer, claim 52 defining location of the humidifier as set forth in claim 33. Note, for example, Fig. 2 of Applicants' original disclosure. Claims 53 and 54, expressly set forth subject matter in claims 49 and 43, claim 53 reciting supply of water to the water permeable layer and then to the flow channels, but are each dependent on claim 50.

The objection to the drawings as set forth in Item 3 on page 3 of the Office Action mailed May 18, 2009, is noted. Applicants have amended their specification to describe reference characters "50" and "210" set forth in Figs. 2 and 5 of the drawings. In view of this amendment to the specification, which does not add new matter to the application (noting original Figs. 2 and 5), it is respectfully submitted that the objection to the drawings as set forth in Item 3 on page 3 of the Office Action mailed May 18, 2009, is moot.

In light of amendments to claims 47 and 48 to recite the "membrane electrode assembly", it is respectfully submitted that the objection to claims 47 and 48 as set forth in Item 4 on page 3 of the Office Action mailed May 18, 2009, has been overcome, and that the required correction has been made.

Applicants respectfully traverse the rejection of their claims under the first paragraph of 35 USC 112, as failing to comply with the written description requirement, particularly insofar as this rejection is applicable to the claims as presently amended. Thus, Applicants have amended claim 47 to delete recitation that the humidifier holding member is for holding peripheries of the "separator". It is respectfully submitted that claim 47 as presently amended is clearly described in

Applicants' original disclosure. In this regard, attention is respectfully directed to Fig. 2 and the structure represented by reference character 210, holding peripheries of the water-retaining layer, water permeable layer and unit fuel cell. It is respectfully submitted that such structure represented by reference character 210, as now described in Applicants' specification, provides the necessary description for satisfying requirements of the humidifier holding member as in claim 47.

The contention by the Examiner in the second paragraph of Item 6, on page 4 of the Office Action mailed May 18, 2009, that the wall 50 and 210 "shown in Figure 2 is construed as a separator having a gas channel 205 facing the water permeable layer 201 on one face and facing the unit cell on the other face so the holder 206 is not partitioned from a gas flow channel with a wall member", is noted. However, it is respectfully submitted that the member for holding as represented by reference characters 210 and 50 constitute the humidifier holding member as in claim 47, and provides the necessary description in connection therewith.

Applicants respectfully traverse the rejection of their claims under the first paragraph of 35 USC 112, as set forth in Item 7 on pages 4 and 5 of the Office Action mailed May 18, 2009, especially insofar as this rejection is applicable to the claims as presently in the application. Claim 48 has been amended to delete recitation of the water permeable layer and separator; and, thus, it is respectfully submitted that claim 48 is clearly supported by the embodiment shown in Fig. 5, including the structure represented by reference characters 50 and 210 describing the necessary humidifier holding member.

The contention by the Examiner in the paragraph bridging pages 5 and 6 of the Office Action mailed May 18, 2009, that the recitation of "a holder" is holder 206.

It is respectfully submitted that the structure represented by reference characters 210 and 50 describe a humidifier holding member as in claim 48, as discussed previously in connection with the holder of claim 47.

The rejections of claims under the second paragraph of 35 USC 112, set forth in Items 10 and 11 on page 6 of the Office Action mailed May 18, 2009, are respectfully traversed insofar as these rejections are applicable to the claims as presently amended. Claim 3 has been amended to recite the thickness of the water-retaining layer; and claims 5-7 have been amended to recite the water permeable "layer", consistent with recitations in claim 47, such that there is clear antecedent basis for recitations in claims 3 and 5-7.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed May 18, 2009, that is, the teachings of Japanese Patent Document No. 08-138704 to Kawazu (Kawazu '704), and Japanese Patent Document No. 08-138705 to Kawazu (Kawazu '705), under the provisions of 35 USC 102 and 35 USC 103.

Initially, note that only claims 33, 40, 43 and 46 have been rejected on prior art, the other claims in the application being free of prior art.

In any event, it is respectfully submitted that these references as applied by the Examiner would have neither disclosed nor would have suggested such a fuel cell assembly as in the present claims, including the recited unit fuel cell and humidifier, and with the humidifier including, inter alia, a water-retaining layer for retaining water therein, this layer being made of a hydrophilic porous material, and a holder for holding peripheries of the water-retaining layer, (a water permeable layer)

and a unit fuel cell, with the holder being provided with a water flow channel therein to exclusively supply water to the water-retaining layer, and wherein a surface of the holder and an adjacent surface of the water-retaining layer are in contact over entire adjacent surfaces thereof (see claims 33 and 50), the fuel cell assembly additionally having a water permeable layer in face-to-face contact with the water-retaining layer, with a surface of the water-retaining layer and an adjacent surface of the water permeable layer being in contact over entire adjacent surfaces thereof (see claim 50).

In addition, it is respectfully submitted that these applied references would have neither disclosed nor would have suggested such a fuel cell assembly as in the present claims, having a plurality of fuel cell units and a humidifier, wherein the humidifier includes, inter alia, a porous water-retaining layer which is in communication with a channel containing water by way of a filter for passing water from the channel to the water-retaining layer, wherein the water-retaining layer communicates with the channel containing water by way of the filter (or by way of an edge of the water-retaining layer), the filter being disposed at a position where the cooling water inlet and the water-retaining layer communicate with each other, wherein the water-retaining layer takes water thereinto at a peripheral portion thereof. See claim 33; note also claim 50.

It is emphasized that the teachings of these applied references would have neither taught nor would have suggested such a fuel cell assembly as in the present claims, having a plurality of fuel cell units and a humidifier, having both the water-retaining layer and water permeable layer as in the present claims, and wherein a surface of the water-retaining layer adjacent a holder therefore, and a surface of the

water retaining layer and an adjacent surface of the water permeable layer, are in contact over entire surfaces thereof, with an edge of the water-retaining layer being in contact with the channel containing water for passing water, but not gas, from the channel to the water-retaining layer. See claim 50.

As will be discussed further infra, according to the present invention a surface of the holder for the water-retaining layer and the surface of the water-retaining layer adjacent thereto, are in contact over entire surfaces thereof; and a surface of the water-retaining layer and an adjacent surface of the water permeable layer are in contact over entire adjacent surfaces thereof. That is, spaces are not formed between (a) the holder for the water-retaining layer and (b) the water-retaining layer, or between the water-retaining layer and the water permeable layer. By avoiding such spaces, e.g., water channels, free water in the liquid state, filling or retained in such channels, can be avoided, so that freezing or vaporization of such free water, which increases volume, thereby damaging the constituent elements inside the fuel cells which are stacked under high pressure, can be avoided.

As will be also discussed further infra, by providing surfaces of the members 206, 203 and 201, for example, in close contact with each other, with water supplied from, e.g., channel 204 through an edge of the water-retaining layer or through a filter, the edge or filter automatically controls an amount of water supplied to the water-retaining layer, providing an additional basis for avoiding free water in the humidifier with resulting damage due thereto as discussed in the foregoing.

As discussed in more detail infra, it is respectfully submitted that the teachings of the applied documents do not disclose, nor would have suggested, such structure as in the present claims, including wherein the humidifier adjoins an end of the

plurality of fuel cell units, with flow channels for flowing gases being partitioned with a wall from the channel containing water, to avoid, e.g., direct transfer of water from the water channel to the gas flow channel.

Furthermore, it is respectfully submitted that these applied references would have neither disclosed nor would have suggested such a fuel cell assembly as in the present claims, having features as discussed previously in connection with claim 33, and, moreover, wherein the filter is a porous carbonaceous filter (see claim 46).

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such fuel cell assembly as in the present claims, having features as in independent claims 33 and 52, as discussed previously, and additionally having features as set forth in the dependent claims, such as (but not limited to), wherein the water-retaining layer has a hydrogen-oxidizing catalyst dispersed therein (note claims 43 and 54); and/or wherein the assembly has a single humidifier (see claim 40); and/or wherein the water-retaining layer is positioned and has structure so as to osmose water through the water-retaining layer by capillary action for transferring water to the flow channels (see claims 49 and 51).

The invention as claimed in the above-identified application is directed to a fuel cell assembly including unit fuel cells, and a power generation system using such fuel cell assembly. In particular, the present invention is directed to such fuel cell assembly, and such power generation system, including polymer electrolyte fuel cells.

As described on page 1 of Applicants' specification, a unit fuel cell of the polymer electrolyte fuel cell (PEFC) includes a membrane-electrode assembly

having a proton exchange membrane, which is a proton-conductive membrane sandwiched between porous electrodes, and a unit cell separator having gas flow channels which supply hydrogen gas to the anode and air (oxygen) to the cathode, respectively. The proton-conductive membrane must be kept wet to a certain level, to let protons move; and various mechanisms have been proposed as apparatus to humidify fuel gasses, as described on pages 2 and 3 of Applicants' specification. Various previously proposed humidifiers have problems such as consuming power, which reduces efficiency of the fuel cell system and disadvantageously increases size of the assembly, and/or existence of free water in the humidifier, which can cause damage to the fuel cell system upon freezing and/or vaporization of the free water.

Against this background, Applicants provide a fuel cell assembly including a humidifier, which avoids problems of previously proposed humidifiers, avoiding a reduction in efficiency of the fuel cells and avoiding an increase in the size of the assembly, and avoiding free water and damage due thereto. The fuel cell units of the present invention are simply constructed of minimum elements, so that total volume is minimized and is fabricated at reduced cost. Furthermore, the present invention, having a minimal number (e.g., one or two) of humidifiers, is very flexible in design thereof.

According to structure of various aspects of the present invention, the holder for the water-retaining layer (e.g., the structure represented by reference character 206 in Figs. 2 and 5) is in contact with the water-retaining layer over entire adjacent surfaces thereof, and/or the water-retaining layer and water permeable layer are in contact with each other over entire adjacent surfaces thereof, leaving no

space for collection of free water between these structures, including no channel for passage of, e.g., free water between these structures. By avoiding the spaces, including, for example, channels, which at least collect, or become filled with, free water which may freeze or vaporize to increase volume thereof, damage to constituent elements inside the fuel cells due to such increased volume can be avoided.

Furthermore, according to structure of various aspects of the present invention, the channel containing water (water flow channel), e.g., of the holder, exclusively transfers water to the water-retaining layer. In addition, there is limited communication of the water-retaining layer with the channel containing water, at the periphery of the water-retaining layer. Furthermore, the channel containing water does not transfer water to a gas passage, there being a wall member partitioning gas flow channels from the channel containing water.

In particular, it is emphasized that according to the present invention, water from the channel containing water, e.g., for humidification, is exclusively transferred to the water-retaining layer, where it is held until used when the fuel cell is operating. This avoids various problems, including the problem of free water which may freeze in the fuel cells.

In this regard, it is important to prevent water freezing, in fuel cell assemblies as in the present invention. Fuel cells will be used for automobiles or for home power generation instruments, as disclosed, for example, on page 38, lines 2-14, of Applicants' specification. It is respectfully submitted that where the fuel cells are utilized for automobiles or for home power generation, the fuel cells should have some countermeasures for preventing water from freezing, because fuel cells for

automobiles and home use likely will encounter water freezing, in various climates, at the time of stopping the fuel cells. Prevention of water freezing in the fuel cell assembly, when the fuel cell is not in use, is a common problem in fuel cells in actual use. Prevention of such freezing is an important objective in the field of fuel cells, in applying such fuel cells to actual use in automobiles and in the home.

In particular, free water in fuel cells, at the time that the fuel cells are not being operated, is a source of the freezing problem, and such free water needs to be removed in order to avoid the freezing problem. In the present invention, water is supplied to the water-retaining layer from a water flow channel in the frame of the fuel cell assembly. The water flow channel of the fuel cell is, illustratively (and not to be limiting), a manifold, as shown, for example, in Figs. 2 and 5 of Applicants' disclosure, and this water flow channel is simple in structure, compared with water passages formed in a separator for cooling water, in various previously proposed fuel cells. Since free water is present only in the manifold in the fuel cell assembly of the present invention, and not, for example, substantially in the water-retaining layer or other structure of the assembly, the water is easily removed from the manifold by gravity, e.g., by opening a valve when the fuel cell is stopped, as shown in Fig. 6 of Applicants' disclosure, wherein water for humidification is removed from the fuel cell assembly by gravity.

In contrast, and as will be discussed in connection with the applied Kawazu references, free water is present in water flow passages in conventional fuel cells. Water flow passages, for example, in a separator, have a relatively complicated structure such as a serpentine structure, and extend over the entire planar area of the fuel cell, not just at an edge or at the periphery thereof for feed to a water-

retaining layer as in the present invention in various features thereof. In addition, the water flow passages have a small sectional area. Therefore, it is very difficult to remove water present in these water flow passages when conventional fuel cells are stopped. Such water flow passages in conventional fuel cells have horizontal and vertical portions forming a serpentine structure, leading to difficult removal of water when the fuel cell is stopped.

According to the present invention, the structure for humidification supplies water exclusively to the water-retaining layer. Such water is provided exclusively either directly to the water-retaining layer (through the edge thereof) or via a filter to the peripheral portion of the water-retaining layer. In any event, water from the water flow channel is transmitted and held in the water-retaining layer, and, in particular, is held therein when the fuel cell is stopped. Thus, according to the present invention, free water is avoided in the fuel cell, because free water in the water flow channel is easily removed from the fuel cell at the time that the fuel cell stops operation. Water retained in the water-retaining layer is not free water, and, hence, it does not freeze to substantially increase its volume so as to thereby cause damage to the fuel cell. That is, even if the water contained in the water-retaining layer freezes, the increased volume can be absorbed by the porous material. As a result, it is possible to avoid damage to structural members of the fuel cell, even when the fuel cell stops operation at temperatures below 0°C. Therefore, prevention of freezing of water, and damage to the fuel cell structure caused by frozen water, can be avoided by the present invention.

In contrast, in a conventional fuel cell, where water remains in the fuel cell and freezes at the time when the fuel cell is not in operation, the frozen water becomes

larger in volume and applies pressure to structural members constituting the fuel cell. As a result, the structural members may be damaged or destroyed, caused by the presence of free water in the fuel cell, particularly in the water flow passage.

Free water is not present in the fuel cell of the present invention, because the water-retaining layer absorbs any water in accordance with its absorption capacity. The water-retaining layer does not retain water beyond its absorption capacity; and, furthermore, empty pores remain in parts of the water-retaining layer absorbing any increased volume of frozen water. Therefore, the fuel cell assembly according to the present invention is not damaged by an increased volume of frozen water.

Thus, with the structure according to the present invention, damage of the assembly, both of the humidifying apparatus and of the fuel cells, caused by free water which freezes, can be avoided.

Furthermore, according to that aspect of the present invention using a filter, the filter does not contact directly with gas, and a supply amount of water to the water-retaining layer can be controlled by the filter. This avoids free water that is not held by the micro-pores of the water-retaining layer. Since the filter does not face directly to the gas flow channels, and since the filter does not receive any influence of gas pressure, it is possible to supply a stable humidifying amount even when gas pressure changes.

The objectives of the present invention are further achieved by utilizing the humidifier having a water-retaining layer with, e.g., a mean micro-pore diameter and thickness as in various of the present claims, particularly wherein this water-retaining layer is made of a hydrophilic porous member, and wherein this water-retaining layer is used together with a water permeable layer that faces gas flow channels of the

fuel cells, and whereby water is retained by capillary force by the water-retaining layer when the fuel cells are not working, and is taken by the oxidizing/fuel gases against the capillary force when the plurality of fuel cells is working. Using apparatus (the humidifier) as in the present invention, excess humidification of the fuel/oxidizing gases can be avoided, and a simple and effective humidification of the fuel/oxidizing gases can be provided, with other advantages as discussed previously.

Moreover, through use of present structure having the water-retaining layer and the water permeable layer that faces the gas flow channels, when the fuel cells are not operating the humidifying water held in the water-retaining layer remains held in micro-pores of the water-retaining layer by capillary force, preventing the, e.g., anode gas from being humidified too much and reducing the humidity of the anode gas.

Kawazu '704 discloses a hydrogen gas humidifier constituted with a porous film, and separators which interpose the porous film from both sides and form a hydrogen gas flow path and a water flow path respectively. The porous film 111 is a polyolefin porous film and has a hydrophilic nature. This patent document discloses that water is easily vaporized by receiving heat from both the porous film and the hydrogen gas, humidification being conducted in a state of steam.

As can be seen, Kawazu '704 includes water flow channels 115p formed in the separator 115, which is in contact with porous membrane 111 and which permeates water to the porous membrane 111. It is emphasized that according to Kawazu '704, the water channels 115p are formed through which free water flows. It is respectfully submitted that the structure in Kawazu '704 would include problems avoided by the present invention, having the contact between entire surfaces of the

recited structures. It is emphasized that according to the present invention, there are no water flow channels or space where free water may collect in the humidifier, so that problems in connection with such free water can be avoided.

In addition, Kawazu '704 would have taught away from supply of water to the edge or periphery parts, of the water-retaining layer, as in the present claims.

Furthermore, it is respectfully submitted that Kawazu '704 would have neither disclosed nor would have suggested such structure as in the present claims, including the filter positioned for transferring water from the channel to the water-retaining layer as in the present claims, and advantages due thereto.

Moreover, in Kawazu '704 the porous carbon 610 contacts the gas; the porous carbon 610 is used for preventing breakage of the porous membrane 111 due to pressure differences. It is respectfully submitted that the position and function of the porous carbon in Kawazu '704 are different from those of the filter according to the present invention.

Furthermore, it is respectfully submitted that Kawazu '704 would have neither disclosed nor would have suggested such a fuel cell assembly as in the present claims, wherein, inter alia, the channel containing water exclusively supplies water to the water-retaining layer, the water-retaining layer being in communication with this channel containing water by way of a filter, and advantages thereof as discussed in the foregoing.

Moreover, positioning of the porous carbon 610 in Kawazu '704 is again noted; in view thereof, the cooling water channels or gas flow channels may be clogged by the filter when portions of the filter are deformed or broken, due to conditions such as when there is an increase in pressure differential. Moreover,

when freezing of cooling water takes place in the structure of Kawazu '704, the filter may be broken, and the humidifier will not work. Such problems are avoided by the present invention, including the filter as in the present claims, positioned as set forth therein. In particular, and as set forth previously, if water freezes at the filter, in the structure of the present invention, supply of water from the filter stops, thereby to prevent breakage of the water-retaining layer or water permeable layer by freezing.

It is respectfully submitted that the additional teachings of Kawazu '705 would not have rectified the deficiencies of the teachings of Kawazu '704, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Kawazu '705 discloses a fuel cell humidifier, constituted with a porous film 21, a catalyst reaction layer 22 formed on its one side surface, and separators 24 which interpose the porous film 21 and the catalyst reaction layer 22 from both sides and form a hydrogen gas flow path 23p and a water flow path 24p respectively. Water in the water flow path 24p permeates the porous film 21 and the catalyst reaction layer 22 according to a difference between the pressure of water flowing in the water flow path 24p and the pressure of hydrogen gas 23p flowing in the hydrogen gas flow path 23p. Note the Abstract of Kawazu '705.

Even assuming, arguendo, that the teachings of Kawazu '705 were properly combinable with the teachings of Kawazu '704, such combined teachings would have neither disclosed nor would have suggested, and in fact would have taught away from, the recited structure whose adjacent surfaces are in contact with each other, thereby avoiding spaces therebetween in which free water can collect, avoiding problems of previous structures such as the Kawazu references, and/or

passage of water from the channel to the water-retaining layer, and advantages thereof.

Moreover, even assuming, arguendo, that the teachings of Kawazu '704 and Kawazu '705 were properly combinable, such combined teachings would have neither disclosed nor would have suggested the structure of the present claims, including, among other features, the humidifier including the water-retaining layer together with the holder, which the holder being partitioned from a gas flow channel with a wall member and being provided with a water flow channel therein to exclusively supply water to the water-retaining layer, and advantages thereof as discussed in the foregoing.

Even assuming, arguendo, that the teachings of Kawazu '705 were properly combinable with the teachings of Kawazu '704, such combined teachings would have neither disclosed nor would have suggested the structure of the present claims, including, among other features, the humidifier comprising the water-retaining layer as defined in the present claims together with the holder, with the gas flow channels being partitioned with a wall from the channel containing water to e.g., exclusively supply water to the water-retaining layer, and advantages thereof as discussed in the foregoing.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently pending in the above-identified application are respectfully requested.

To the extent necessary, Applicants hereby petition for an extension of time under 37 CFR 1.136. Kindly charge any shortage of fees due in connection with the filing of this paper, including any extension of time fees, to the Deposit Account of

Antonelli, Terry, Stout & Kraus, LLP, Account No. 01-2135 (case 520.43216X00), and please credit any overpayments to such Deposit Account.

Respectfully submitted,

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